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drifting sand, and the black glaze is produced by the action of the hot sun on the oxide of iron, which must be partially reduced to the metallic state. The heat of the sun on the rocks on this mesa will reach fully 150° F. for some months, each year, and must produce a powerful effect on the physical character of the rocks. Indeed I am satisfied that if our sedimentary rocks were subjected to strong solar heat and moisture for a period of time, they would be completely metamorphosed. The mesas in this part of Pima county, range from 2000 to 3000 feet above sea level, and the highest mountains are from 8000 to 9000 feet above the sea. The timber on the mesas is locally mesquite, cats' claws (a species of mesquite) and palo verde, and a shrub called by the Mexicans *Edonella*. At an elevation of 4000 to 5000 feet, we find scrub oak, and 7000 to 8000 feet pine. These elevated regions come within the range of prevalent dew falls. While on the mesas dew is seldom or never seen.

GEOGRAPHY AND TRAVELS.¹

THE VOYAGES OF THE WILLEM BARENTS AND THE ISBJORN IN THE BARENTS SEA.—The year 1879 will always be memorable in the record of Arctic exploration for the discovery of the Northeast passage by Nordenskiöld, of whose successful voyage accounts have been given in former numbers of the *NATURALIST*. He has now returned to Europe and been received with great honors at the various cities he has visited on his way to his northern home.

Other less important but still remarkable voyages into the Arctic seas were also made during the last summer.

In the *NATURALIST* for November, 1879, we noticed the sailing of the Dutch North Polar Expedition in the schooner *Willem Barents*, and of Capt. A. H. Markham in the yacht *Isbjorn*. Both having returned, an interesting account of their voyages prepared by Capt. Markham has been read before the Royal Geographical Society.²

The *Willem Barents* found the edge of the pack ice on July 5, in lat. $75^{\circ} 30'$ N., long. 26° E. After stopping at Vardö, the explorers took many deep sea soundings and serial temperatures and obtained dredgings in the Barents sea, arriving in the Matyushin Shar on August 6th. On the 18th they met the *Isbjorn*, and on the 20th they sailed northwards together along the west coast of Novaya Zemlya, soon separating not to meet again. The *Willem Barents*, after placing a memorial stone at Cape Nassau, took a northward course unobstructed by ice on the 54th meridian, and on September 7th they sighted high land, supposed to be Mount Brunn on MacClintock's island, Franz Josef Land, distant about sixteen miles. A broad belt surrounded the land, and the weather being threatening they turned back and arrived safely at Hammerfest on September 24th.

¹ Edited by ELLIS H. YARNALL, Philadelphia.

² Proceedings of the Royal Geographical Society, January, 1880.

The *Willem Barents* is thus the first vessel to sight this distant land and return in safety. This success of a small schooner confirms the judgment of those who have, since the return of the Austrian expedition, advocated the route towards the Pole by the west side of Franz Josef Land.

The *Ishjorn*, a vessel of forty-three tons burthen and fifty-five feet in length, though not able to reach quite so high a latitude, made a very interesting cruise. Sailing from Hammerfest on May 25th, they made the first ice on June 4th, about forty miles west of Goose Land, Novaya Zemlya. On June 20th, they entered the Matyushin Shar. "The scenery in this wonderfully formed channel is very grand, more especially on a fine sunny night, when the rays of the sun at a low altitude just 'bathe in deep joy' the summits of the surrounding hills. These lofty ranges raise their crests to the height of from 3000 to 4000 feet above the level of the sea. Between them undulating valleys recede into the interior, covered with such deep snow as to conceal all rocky projections, and make them resemble glaciers in their milk-white opacity, rather than stretches of country which very shortly would be covered with a rich and luxuriant Arctic flora. Occasionally deep ravines, black and sombre-looking, would separate the hills, their dark black cliffs forming a striking contrast to the universal whiteness that everywhere else predominated."

Capt. Markham noticed here the formation of ice on the surface of the water when the air temperature was as high as 39° , the temperature of the surface water being 31° . This was taking place at the mouth of a large valley where a great quantity of fresh water was discharged into the sea. Finding the strait blocked with ice, they coasted along the north-western shore of Novaya Zemlya until again stopped by ice off Cape Nassau, and had to return to the Matyushin Shar, and, after some delay, passed through it into the Sea of Kara. The point of juncture of the tides from the Sea of Barents and the Sea of Kara, was determined to be at a point near Cape Walrus. The ice in the eastern sea was found to be very heavy. One floe Capt. Markham carefully measured, and found to be thirty-one feet in thickness. This floe was over four miles in diameter. Returning to the straits, the *Willem Barents* was met as mentioned above. After their separation the *Ishjorn* succeeded in rounding Cape Mauritius carrying the British flag for the first time to the northward of Novaya Zemlya. Within thirty miles of Barents' winter quarters at Ice Haven, the refusal of the Norwegian crew to proceed further, compelled them to sail in a north-westerly direction. In lat. $73^{\circ} 8' N.$ they encountered a strong northerly gale, and the heavy sea "was a very sure proof that the pack was a long way off." On September 12th, they reached their highest latitude, $78^{\circ} 24' N.$, on the 47th meridian of longitude. They were here surrounded by loose ice. To some of the fragments soil

was still adhering, and this, and their angular, little-worn sides, as well as the increased number of birds of various sorts, some of which are rarely seen any distance out at sea, were convincing proofs of the proximity of land, which, had they not been enveloped in a dense fog, they might have seen. The position reached was about eighty geographical miles from the land discovered by Payer, which Capt. Markham believes extends in a south-westward direction. The lateness of the season now compelled a return, and they arrived at Tromsø on September 22d.

Should an attempt be made in a steam vessel to reach what is probably an archipelago of islands extending from Franz Josef Land to Spitzbergen, it will have a great promise of attaining a higher latitude than has yet been reached, especially when it is remembered that in latitude 83° , Payer saw precipitous mountain land stretching away to the north, while at the same latitude in Grinnell Land it came to an abrupt end.

Capt. Markham's collections are rich and interesting, and include many specimens of carboniferous fossils from Novaya Zemlya which agree almost species by species with those obtained by Sir George Nares at Cape Joseph Henry. It may be safely affirmed that the greater portion of the Polar region is composed of carboniferous rocks, and that the greater part of the Polar sea north of Franz Josef Land and Spitzbergen probably covers a large area of coal measures. The connection of Spitzbergen with the great range of the Ural mountains can now be shown and the beds found there could be correlated with the beds found in Baffins bay and Grinnell Land, so that a distinct belt of carboniferous and Devonian rocks circles much of the Polar region. The northern extremity of Novaya Zemlya is composed entirely of carboniferous rocks which dip beneath the sea under Franz Joseph Land towards the Pole. The identification of these fossils is so complete and certain that the history of these northern rocks now begins to be perfectly well known.

The collection also embraces about ninety botanical specimens, birds, butterflies, fishes, Crustacea and dredging results.

The *Willem Barents* is to be sent out again this summer on a third cruise.

CIRCUMPOLAR STATIONS — THE AURORA BOREALIS. — At the International Polar Conference held at Hamburg, in October, 1879, to consider the scheme of Count Wilczek and Capt. Weyprecht for the establishment of circumpolar observing stations, it was decided to recommend that such stations should be located in the northern hemisphere, on the north coasts of Spitzbergen and of Novaya Zemlya, the neighborhood of the North Cape, the mouth of the Lena, New Siberia, Point Barrow, West and East Greenland about 75° N. lat.; in the southern hemisphere, in the neighborhood of Cape Horn, Kerguelen or Macdonald

islands, and one of the group south of the Auckland islands. These observatories would endeavor to ascertain the answers to the following questions: 1. Are the differences in the daily periods of magnetic disturbances known to us special in the localities, or are they annual phenomena? 2. How are the disturbance-intensities in different places related to each other? 3. Does the disturbance-intensity stand in a determinate relation to one of the fundamental magnetic elements? 4. In what relation do the disturbances on one side stand to those of the other in the different parts of the Polar region? 5. How does the total intensity in the disturbances behave? 6. How far do the disturbances extend? 7. Are there fixed centers of disturbance, or do they form themselves, and shift positions like barometric depressions? 8. In what connection do the disturbances stand with regard to the zone of greatest intensity and frequency of the aurora borealis? 9. In what connection do they stand with regard to the single aurora? and 10, with the different forms of the aurora? 11. What connection is there between the magnetic phenomena of the Arctic and Antarctic regions? and 12, between them and electric earth currents.

Dr. W. H. Dall, in charge of a corps of the U. S. Coast Survey, expects to visit Behrings strait this summer, and if the season permits will go as far as Point Barrow, to enable him to report on the feasibility of establishing a station there.

A correspondent states in the Proceedings of the Royal Geographical Society, as the result of observations taken for many years in Norway, of the aurora borealis, that "the aurora is neither seen during extreme cold or northerly winds, but appears when an ordinary Arctic temperature is raised by southerly and westerly winds, and is generally followed by snow. In the south-eastern part of Norway it seems to be especially caused by south-easterly winds, which are there very moist, and rather warm. Its appearance is always accompanied by a falling barometer. In my opinion the phenomenon is due to the following causes. When a wind laden with warmth, moisture and electricity comes in contact with a body of cold air, the moisture is converted into snow, the warmth and electricity are thereby released, and the aurora is the result of the disturbance. The northern lights cannot occur in very high latitudes, because the warm moist air is cooled long before it reaches them." * * * * "The determination of the chemical elements involved, by means of spectrum analysis, is by no means the least of the numerous scientific results to be derived from Arctic exploration."

Another recent writer thus defines the principal zone of the aurora: It begins at Barrow point, lat. 72° N., on the northern coast of North America, passes over Great Bear lake towards Hudson's bay, which it crosses in 60° N. lat., sweeps near Nain on the coast of Labrador, turns to the south of Cape Farewell,

goes between Iceland and the Faroe islands, approaches North cape, rounds Novaya Zemlya and Cape Chelyuskin, nearing the coast of Asia at the bay of Nijne Kolimsk, and lastly, returns to Point Barrow.

NAVIGATION OF THE SIBERIAN ARCTIC OCEAN.—The New York *Herald* publishes a translation of a paper prepared by Prof. Nordenskiöld, on board the *Vega*, in the spring of 1879, "On the Possibility of Navigation for Commercial Purposes in the Siberian Arctic Ocean." He discusses at some length the routes and best seasons for navigation between the Obi-Yenisei and the Atlantic. As regards the feasibility of the passage westward through Behring strait, he remarks that owing to the rotation of the earth, that portion of the great warm current from the south called the Korosivo, which is deflected into Behring strait, would tend towards the east and not towards the north-west along the coast of Asia, as indicated by many charts. And that there was no such current on that coast, was proved by the investigations made by his expedition. "The currents in the sea or in the large gulf formed by Wrangell's Land, the north-east shore of Asia and the north-west shore of America, resemble rather the currents of Greenland and of the Sea of Kara. In all those waters a warm current from the south extends along the coast of the land situated to the east, and, in the sea in question, goes from Behring strait to Cape Barrow. All tends to the belief that in the waters north of Behring strait this southern current is counterbalanced—as in the Sea of Greenland and that of Kara—by a current of cold water passing a little to the west of Cape Barrow, at first toward the south, then toward the south-west. This cold current carries along considerable masses of ice formed at a great distance northward, toward the eastern coast of Wrangell's Land, rendering the access to it difficult. In the vicinity of the seventieth degree of latitude the land prevents it from following its route further to the south-west. It is probable that it is then again thrown in a north-west direction, that it traverses Long Sound in doubling the south-west point of Wrangell's Land, and that it again enters into the polar basin, flowing under the currents of the east, which are warm, but little salt, and consequently light, and which are produced by the large rivers of Siberia. It is clear that this current must exert an influence little favorable to the condition of the ices between Cape Schelagskoï and Behring strait. Other circumstances tend, however, to diminish the quantity of ice and produce along the coast an open channel, navigable perhaps every year, at least for vessels of light draught. This coast is situated under a latitude southern enough for the new ice formed along its shores in the winter season to melt in a great measure during the summer, so that at the end of the hot season there remain only great mountains of ice, agglomerated in

winter, or descending with the winds and currents from colder northern regions. Most commonly this large ice is so deep that it is grounded at 5.34 metres to 8.91 metres of water. Now, as the depth of the sea diminishes generally in a uniform manner toward the shore (save where mountains project in promontories), there remains a free channel very wide at the immediate proximity of the shore. A vessel not drawing more than twelve feet can float in all security in this water." Prof. Nordenskiöld closes with the following recapitulation:

"What I have said may be summed up in the following points:

"*First.*—This route by sea from the Atlantic to the Pacific along the northern shores of Siberia ought to be frequently navigable in a few weeks by a suitable steamer having aboard experienced mariners; but it is not very probable, from the knowledge that we actually possess of the Ice sea of Siberia, that this route will become in its totality of great importance to commerce.

"*Second.*—It may already be given as a thesis that there exists no difficulties for the utilization, as a commercial route, of the sea between the Obi-Jenisei and Europe.

"*Third.*—According to all probability the route by sea between the Jenisei and the Lena and between the Lena and Europe can be equally utilized as routes of commerce, but the going and returning between the Lena and Europe cannot be effected in the course of the same summer.

"*Fourth.*—Ulterior explorations are necessary to decide on the possibility of maritime commercial relations between the mouth of the Lena and the Pacific. The experience acquired by our expedition shows that in any case there can be introduced by that route from the Pacific into the basin of the Lena, in steamers, heavy engines and other effects which cannot be transported conveniently on sledges and wagons."

The entire absence of scurvy during the voyage of the *Vega* is attributed by Prof. Nordenskiöld to the free use of a curious little berry that springs out of the eternal ice and snow during the short summer. It bears profusely, and has a taste like the raspberry but more acid. The fruit is dried and then mixed with the milk of the reindeer, and can be carried frozen for thousands of miles. Lieut. Hovgaard states, as another reason for the good health of the party, that on no occasion was the daylight quite wanting and even on the shortest day, although the sun did not rise above the horizon, there was a couple of hours of daylight.

As experiments recently made in England show that vegetable and plant life is produced and stimulated as well by the electric as by the sun's light, its use on board of vessels in the Arctic seas might be found advisable not only as a promoter of comfort and cheerfulness but as a direct sanitary agent.

The Danish steamer, *A. E. Nordenskiöld*, which was sent out by M. Siberiakoff to the relief of her namesake, and was stranded in

August, 1879, off the east coast of Yesso has been gotten off safely. She will be refitted, placed under the command of Capt. E. Johannesen, who discovered Ensomheden island, and will attempt the north-east passage in the reverse direction.

“DIE METAMORPHOSEN DES POLAREISES.”—This is the title of a valuable work by Capt. Weyprecht, recently published in Vienna, and treating very fully of the character, changes and movements of the Arctic ice.

The first chapter speaks of the three different kinds of ice—glacier, salt-water and fresh-water. This is followed by others discussing ice-pressures, ice in winter and in summer, and the changes in its surface caused chiefly by variations of temperature between the water below and the air above—these effects being often increased by the banks and mounds of same. The weight of these snow masses, the pressure of surrounding ice-fields driven by the winds or currents, and the forcing of large blocks over and under the ice surface are also effecting constant changes in the surface of the frozen sea. These changes are accompanied by frequent noises. Sometimes only a mere murmur is heard, but often there is a groaning and roaring as if heavily laden wagons were running over the icy surface.

Noise is conducted a long distance on the ice, and sounds at the margin of the floe often seem directly under your feet. “Whenever” Capt. Weyprecht says, “I laid down to sleep, and placed my ear against the ship’s side, a humming and confusion of sounds could be heard—the combination of noises on the ice at great distances from the ship.” The movements of the ice—each field possessing a different velocity, the different effects caused by the winds and currents on the various masses, owing to the irregularities of the upper and under surfaces of the fields, the slow movement of the great iceberg and the rapid velocity of many ice-fields are also pointed out as characteristic features of Arctic ice heretofore little understood.

It is to be wished that Capt. Weyprecht’s investigations had extended to the shores of the Palæocrystic sea of the British expedition, where most of these phenomena are visible on a grander scale than can elsewhere be witnessed. Our knowledge of Arctic ice must continue to be very incomplete until we learn more of the origin and duration of these mightiest of all known ice masses.

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SCIENTIFIC NEWS.

— The Count de Castelnau, for many years French Consul at Melbourne, died there recently. He was an ardent student of natural history, and had pursued his studies in the various parts of the world whither his official duties led him. He was director of the scientific expedition sent by Louis Phillippe, the King of